(b) It is recommended that the test be made at a temperature that will minimize the possibility of brittle fracture. The test pressure shall not be applied until the component, appurtenance or system, and the pressurizing fluid are at approximately the same temperature.

ND-6220 HYDROSTATIC TEST PRESSURE REQUIREMENTS

ND-6221 Minimum Hydrostatic Test Pressure

(a) The installed system shall be hydrostatically tested at not less than 1.25 times the lowest Design Pressure of any component within the boundary protected by the overpressure protection devices that satisfy the requirements of ND-7000.

(b) Valves shall be hydrostatically tested in accordance with the rules of ND-3500.

(c) Other components shall be hydrostatically tested at not less than 1.25 times their Design Pressure.

(d) As an alternative to (a) above, piping between the discharge side of a centrifugal pump and the first shutoff valve may be hydrostatically tested at the shutoff head of the pump. The pressure shall be maintained for a sufficient time to permit examination of all joints, connections, and regions of high stress.

ND-6222 Maximum Permissible Pressure

(a) If the maximum test pressure of ND-6221(a) or ND-6221(d) is to be exceeded by 6% at any location, the upper limit shall be established by analysis using all loadings that may exist during the test.

(b) When testing a system, the test pressure shall not exceed the maximum permissible test pressure of any component in the system.

ND-6223 Hydrostatic Test Pressure Holding Time

The hydrostatic test pressure shall be maintained a minimum of 10 min prior to initiation of the examination for leakage required by ND-6224.

ND-6224 Examination for Leakage After Application of Pressure

Following the application of the hydrostatic test pressure for the required time (ND-6223), all joints, connections, and regions of high stress such as regions around openings and thickness transition sections shall be examined for leakage. Except in the case of pumps and valves, which shall be examined while at test pressure, this examination shall be made at a pressure equal to the greater of the Design Pressure or three-fourths of the test pressure, and it shall be witnessed by the Inspector. Leakage of temporary gaskets and seals, installed for the purpose of conducting the hydrostatic test that will later be replaced, may be permitted unless the leakage exceeds the capacity to maintain system test pressure for the required amount of time. Other leaks, such as from permanent seals, seats, and gasketed joints in components, may be permitted when specifically allowed by the Design Specifications. Leakage from temporary seals or leakage permitted by the Design Specification shall be directed away from the surface of the component to avoid masking leaks from other joints.

ND-6230 BELLOWS EXPANSION JOINTS

The hydrostatic test requirements for bellows expansion joints shall be as required in (a) through (c) below.

(a) The completed expansion joint shall be subjected to a hydrostatic test in accordance with the applicable provisions of this Article as supplemented by the Design Specifications.

(b) This test may be performed with the bellows fixed in the straight position, at its neutral length, when the design has been shown to comply with ND-3649.4(e)(1) or ND-3649.4(e)(2). If the design is to comply with ND-3649.4(e)(3), this test shall be performed with the bellows fixed at the maximum design rotation angle or offset movement.

(c) In addition to inspecting the expansion joint for leaks and general structural integrity during the test, the Inspector shall also visually inspect the bellows for evidence of meridional yielding as defined in ND-3649.4(b) and for evidence of squirm as defined in ND-3649.4(c). If the design is to comply with ND-3649.4(e)(3), actual measurements shall be made before, during, and after the pressure test in accordance with ND-3649.4(b) and ND-3649.4(c).

ND-6240 PROVISION FOR EMBEDDED OR INACCESSIBLE WELDED JOINTS IN PIPING

When welded joints in piping subassemblies or piping systems will be embedded or otherwise inaccessible for inspection at the time of the system hydrostatic test, either of the following alternatives may be employed. Alternative (b) does not apply to brazed joints.

(a) The piping subassembly, or portion of the piping system that is to be embedded, or will otherwise be inaccessible, shall be hydrostatically tested at some point in the fabrication or installation prior to embedment or inaccessibility.

(b) Radiography shall be performed on all circumferential butt welds, and either magnetic particle or liquid penetrant examination shall be performed on all fillet or socket welds in accordance with the requirements of ND-5000. The longitudinal butt welds shall meet the requirements of ND-2000. The hydrostatic test may then be performed after embedment using maintenance of pressure as the acceptance criterion for those welds only. The system shall be pressurized to the hydrostatic test pressure and then isolated from the pressurizing source for a period of 1 hr/in. (2 min./mm) of wall thickness but not less than 1 hr. During the test period, there shall be no drop in pressure.
NC-6212 Test Medium and Test Temperature

(a) Water or an alternative liquid, as permitted by the Design Specification, shall be used for the hydrostatic test.

(b) It is recommended that the test be made at a temperature that will minimize the possibility of brittle fracture. The test pressure shall not be applied until the component, appurtenance, or system and the pressurizing fluid are at approximately the same temperature.

NC-6220 HYDROSTATIC TEST PRESSURE REQUIREMENTS

NC-6221 Minimum Hydrostatic Test Pressure

(a) The installed system shall be hydrostatically tested at not less than 1.25 times the lowest Design Pressure of any component within the boundary protected by the overpressure protection devices which satisfy the requirements of NC-7000.

(b) Vessels designed in accordance with NC-3200 shall be hydrostatically tested at not less than 1.25 times the Design Pressure.

(c) Valves shall be hydrostatically tested in accordance with the rules of NC-3500.

(d) Other components shall be hydrostatically tested at not less than 1.25 times their Design Pressure.

(e) As an alternative to (a) above, piping between the discharge side of a centrifugal pump and the first shutoff valve may be hydrostatically tested at the shutoff head of the pump. The pressure shall be maintained for a sufficient time to permit examination of all joints, connections, and regions of high stress.

NC-6222 Maximum Permissible Pressure

(a) If the minimum test pressure of NC-6221(a) or NC-6221(d) is exceeded by 6% at any location, the upper limit shall be established by analysis using all loadings that may exist during the test.

(b) For vessels designed to NC-3200, the stress limits of NC-3218 shall be used in determining the maximum permissible pressure.

(c) When testing a system, the test pressure shall not exceed the maximum permissible test pressure of any component in the system.

NC-6223 Hydrostatic Test Pressure Holding Time

The hydrostatic test pressure shall be maintained a minimum of 10 min prior to initiation of the examination for leakage required by NC-6224.

NC-6224 Examination for Leakage After Application of Pressure

Following the application of the hydrostatic test pressure for the required time (NC-6223), all joints, connections, and regions of high stress such as regions around openings and thickness transition sections shall be examined for leakage. Except in the case of pumps and valves, which shall be examined while at test pressure, this examination shall be made at a pressure equal to the greater of the Design Pressure or three-fourths of the test pressure, and it shall be witnessed by the Inspector. Leakage of temporary gaskets and seals, installed for the purpose of conducting the hydrostatic test, and which will be replaced later, may be permitted unless the leakage exceeds the capacity to maintain system test pressure for the required amount of time. Other leaks, such as from permanent seals, seats, and gasketed joints in components, may be permitted when specifically allowed by the Design Specifications. Leakage from temporary seals or leakage permitted by the Design Specification shall be directed away from the surface of the component to avoid masking leaks from other joints.

NC-6230 BELLOWS EXPANSION JOINTS

The hydrostatic test requirements for bellows expansion joints shall be as required in (a) through (c) below.

(a) The completed expansion joint shall be subjected to a hydrostatic test in accordance with the applicable provisions of this Article as supplemented by the Design Specifications.

(b) This test may be performed with the bellows fixed in the straight position, at its neutral length, when the design has been shown to comply with NC-3649.4(e)(1) or NC-3649.4(e)(2). If the design is to comply with NC-3649.4(e)(3), this test shall be performed with the bellows fixed at the maximum design rotation angle or offset movement.

(c) In addition to inspecting the expansion joint for leaks and general structural integrity during the test, the Inspector shall also visually inspect the bellows for evidence of meridional yielding as defined in NC-3649.4(b) and for evidence of squirm as defined in NC-3649.4(c). If the design is to comply with NC-3649.4(e)(3), actual measurements shall be made before, during, and after the pressure test in accordance with NC-3649.4(b) and NC-3649.4(c).

NC-6240 PROVISION FOR EMBEDDED OR INACCESSIBLE WELDED JOINTS IN PIPING

When welded joints in piping subassemblies or piping systems will be embedded or are otherwise inaccessible for inspection at the time of the system hydrostatic test, either of the following alternatives may be employed. Alternative (b) does not apply to brazed joints.

(a) The piping subassembly, or portion of the piping system which is to be embedded, or will be otherwise inaccessible, shall be hydrostatically tested at some point in the fabrication or installation prior to embedment or inaccessibility.

(b) Radiography shall be performed on all circumferential butt welds, and either magnetic particle or liquid penetrant examination shall be performed on all fillet or socket welds in accordance with the requirements of NC-5000. The longitudinal butt welds shall meet the
ND-6127 Check of Test Equipment Before Applying Pressure

The test equipment shall be examined before pressure is applied to ensure that it is tight and that all low pressure filling lines and other items that should not be subjected to the test have been disconnected or isolated.

ND-6200 HYDROSTATIC TESTS

The requirements of this paragraph apply to all components except tanks for which ND-6500 applies.

ND-6210 HYDROSTATIC TEST PROCEDURE

ND-6211 Venting During Fill Operation

The component or system in which the test is to be conducted shall be vented during the filling operation to minimize air pocketing.

ND-6212 Test Medium and Test Temperature

(a) Water or an alternative liquid as permitted by the Design Specification shall be used for the hydrostatic test.

(b) It is recommended that the test be made at a temperature that will minimize the possibility of brittle fracture. The test pressure shall not be applied until the component, appurtenance or system and the pressurizing fluid are at approximately the same temperature.

ND-6220 Hydrostatic Test Pressure Requirements

ND-6221 Minimum Hydrostatic Test Pressure

(a) The installed system shall be hydrostatically tested at not less than 1.25 times the lowest design pressure of any component within the boundary protected by the overpressure protection devices which satisfy the requirements of ND-7000.

(b) Valves shall be hydrostatically tested in accordance with the rules of ND-3500.

(c) Components exclusive of piping systems shall be hydrostatically tested at not less than 1.50 times their design pressure.

ND-6222 Maximum Permissible Pressure

(a) If the minimum test pressure of ND-6221(a) or (d) is to be exceeded by 6% at any location, the upper limit shall be established by analysis using all loadings that may exist during the test.

(b) When testing a system, the test pressure shall not exceed the maximum permissible test pressure of any component in the system.

ND-6223 Hydrostatic Test Pressure Holding Time

The hydrostatic test pressure shall be maintained a minimum of 10 minutes prior to initiating the examination for leakage required by ND-6224.